

CLAIMS

1. A method for analysing a stream of particulate material containing crystalline substances including

(i) extracting a sample flow from the stream of particulate material,

(ii) smoothing and flattening a surface of said sample flow to prepare said sample flow for X-ray diffraction measurements,

(iii) directing an X-ray beam onto the smoothed and flattened surface of the sample flow as it passes through a measurement station and detecting diffracted X-rays over an angular range to provide a diffraction pattern,

(iv) analysing the diffraction pattern to determine a composition for crystalline substances in the sample,

(v) repeating step (iii) to provide diffraction patterns from the continuously moving sample at predetermined intervals, and

(vi) repeating step (iv) for each diffraction pattern from step (v),

whereby a series of sequential composition determinations from the sample flow are provided which represent the composition of crystalline substances in the stream of particulate material.

2. A method as claimed in claim 1 wherein the diffracted X-rays of step (iii) are simultaneously detected over the angular range.

3. A method as claimed in claim 2 wherein the diffraction patterns are analysed using a whole pattern analysis method.

4. A method as claimed in claim 3 wherein the diffraction patterns are analysed using the Rietveld method.

5. A method as claimed in claim 1 wherein step (ii) includes,

feeding the sample onto a continuously moving carrier and smoothing and flattening its surface.

6. A method as claimed in claim 5 wherein the sample is formed into a bed on the moving carrier.

7. A method as claimed in claim 6 wherein the carrier includes an endless groove for receiving the sample and the sample is packed into the groove to form the bed.

8. A method as claimed in claim 5 wherein following step (iii) the sample is continuously removed from the carrier prior to feeding further sample onto the carrier.

9. A method as claimed in claim 1 wherein the stream of particulate material is cement clinker and the method includes a step of cooling and crushing a portion of the cement clinker to provide the sample flow.

10. A method as claimed in claim 1 wherein the stream of particulate material is cement.

11. A method for continuously presenting a sample from a stream of particulate material containing crystalline substances for obtaining X-ray diffraction analyses of the particulate material, including

(i) extracting a sample flow from the stream of particulate material,

(ii) feeding the sample flow onto a continuously moving carrier and smoothing and flattening its surface,

(iii) continuously moving the carrier to move the sample through a station for performing X-ray diffraction measurements on said flat and smooth sample surface, and

(iv) continuously removing the sample from the carrier prior to feeding further sample flow onto the carrier.

12. Apparatus for analysing a stream of particulate material containing crystalline substances, including

means for extracting a sample flow from the stream of particulate material,

means for smoothing and flattening a surface of said sample flow to prepare the sample flow for X-ray diffraction measurements,

a measurement station including an X-ray generator and position sensitive detector for detecting X-ray diffraction patterns from the prepared sample flow,

processor means for analysing the X-ray diffraction patterns to determine a composition for crystalline substances in the sample from each diffraction pattern and for providing a series of sequential composition determinations, thereby representing the composition of crystalline substances in the stream of particulate material.

13. Apparatus as claimed in claim 12 wherein the position sensitive detector of the measurement station is a curved position sensitive detector for simultaneously detecting diffracted X-rays over an angular range.

14. Apparatus as claimed in claim 12 wherein the position sensitive detector is an area detector.

15. Apparatus as claimed in claim 12 wherein the means for smoothing and flattening a surface of the sample flow includes a carrier for receiving the extracted sample flow, the carrier being drivable for continuous movement, whereby said means for smoothing and flattening the surface of the sample operates on the carrier as the carrier moves and prior to the carrier conveying the sample flow through the measurement station.

16. Apparatus as claimed in claim 15 wherein the carrier includes an endless groove and said means for smoothing and flattening the surface of the sample packs the sample into the groove.

17. Apparatus as claimed in claim 16 wherein said means for smoothing and flattening the surface of the sample is a driven roller positioned over the endless groove.

18. Apparatus as claimed in claim 17 including means for removing excess sample from the carrier prior to said means for smoothing and flattening the surface of the sample packing the sample into the endless groove.

19. Apparatus as claimed in claim 18 wherein said means for removing excess sample includes a scraper and vacuum apparatus.

20. Apparatus as claimed in claim 15 wherein the carrier is formed for the sample to be removed therefrom, or the apparatus includes means for removing the sample therefrom, prior to where the carrier receives the extracted sample flow and after the sample passes the measurement station.

21. Apparatus as claimed in claim 16 wherein the carrier is a horizontal wheel mounted for rotation about a vertical axis, and the endless groove is an annular groove in an upper surface of the wheel.

22. Apparatus as claimed in claim 20 wherein the apparatus includes means for removing the sample from the carrier prior to where the carrier receives the extracted sample flow, which means for removing the sample includes a scraper and vacuum apparatus.

23. Apparatus for presenting a sample from a stream of particulate material for X-ray diffraction measurements including,

a carrier for receiving a continuous feed of the particulate material, the carrier being drivable for continuous movement, and

means for preparing the sample on the carrier and for smoothing and flattening the surface of said sample,

wherein the carrier is such that said sample is removed, or the apparatus includes means for removing said sample therefrom, as the carrier moves, the removal of the

sample occurring prior to where the carrier receives the feed of sample and after the sample passes a measurement station.